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HEADQUARTERS
AIR FORCE SPACE COMMAND

CONCEPT OF OPERATIONS
FOR
SATELLITE CONTROL

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PREFACE

We developed this mission area Concept of Operations (CONOPS) to describe how Air Force Space Command (AFSPACECOM) will conduct future satellite control operations and provide enhanced capabilities in support of designated users. This overarching CONOPS will incorporate the concepts of Integrated Satellite Control (ISC), **simplified and advanced** satellite control, **and** the evolution of the Air Force Satellite Conuol Network (AFSCN) to a future operating capability that is endurable, flexible, and the "Network of Choice" for all DoD and other satellite control operations.

AFSPACECOM will develop separate CONOPS to address specific satellite programs and other mission areas such as spacelift operations. AFSPACECOM/DO will ensure consistency between the various CONOPS. In addition, the 50th Space Wing will develop system-specific Employment Concepts as needed to document their satellite control roles and responsibilities in support of and consistent wirh these CONOPS.

This CONOPS supersedes the Draft AFSCN Operations Concept (S) dated, 21 September 1990 and dovetails with policy and guidance identified in the most current version of the following documents: (Note: The date signifies the latest version; it does 'not indicate signature/approval.)

-- Mission Need Statement (MNS) for Satellite Operations (Draft)	20 October 1933
-- MNS for an Integrated Satellite Control (ISC)	7 October 1992
-- Air Force Satellite Conuol Network (AFSCN) Definition Document	23 February 1993
-- Program Management Directive (PMD), 9033 (IS), for AFSCN	12 March 1992
-- PMD, 0042 (15). for Consolidated Space Operations Center	12 March 1992
-- PMD, 9267 (4), for Consolidated Space Test Center	12 March 1992
-- Space System Threat Environment Description, DST-2660F-727-91	s March 1991
-- Air Force Manual 1-1, Volume 1	March 1992
-- Chairman, Joint Chiefs of Staff Memorandum of Policy No. 37	14 May 1992
-- Satellite Control Operational Requirements Document (ORD) (Draft)	21 May 1993
-- *A Post Cold War Assessment of U.S. Space Policy* by the Vice President's Space Policy Advisory Board	December 1992
-- FY 1993 National Dciense Authorization Act (H.R. 5006 Sec. 154)	4th Quarter 1992
-- *Roles. Missions, and Functions of the Armed Forces of the U.S* by Army General Colin Powell, Chairman JCS	February 1993
-- Blue Ribbon Panel on Space	January 1993

CONCEPT OF OPERATIONS

FOR

SATELLITE CONTROL

1.0 Introduction.

1.1 The Unified Command Plan assigns to the Commander in Chief (CINC) of US Space Command (USCINCSPACE) Combatant Command (COCOM) over space forces in support of Unified and Specified (U&S) CINCs. To effectively command and control these forces, Air Force Space Command (AFSPACECOM) provides vital support to space systems during peace, war and all intermediate levels of conflict. Currently, AFSPACECOM uses resources of the Air Force Satellite Control Network (AFSCN) for this support. The Commander, AFSPACECOM is responsible for the AFSCN and has delegated responsibility for the operation and management of AFSCN resources to the Commander, 50th Space Wing (50 SPW). The 50 SPW provides satellite command and control, mission data dissemination, and other mission support services and/or resources designated by space programs and users.

1.2 It is envisioned that the current AFSCN will evolve into a fully integrated Satellite Control System (SCS), encompassing the elements of a Space Segment (SS) and a Ground Segment (GS). The future GS will evolve from the AFSCN's common-user and dedicated resources and their associated interfaces to other systems. The future SS will consist of space-based systems for control of satellites and/or satellite control resources on-board all Department of Defense (DoD) COCOM satellite systems as well as selected National; Allied; Civil; Research, Development, Test, and Evaluation (RDT&E); or other satellite systems (non-DoD) that require support from the SCS.

2.0 Scope. This Concept of Operations (CONOPS) describes the SCS operations methodologies for AFSPACECOM programs and the resource environment provided to external users. It calls for evolution from today's AFSCN to less manpower intensive, more highly automated, and more standardized SCS configurations and operations designed and operated with the goal of truly becoming the "Network of Choice" for both DoD and non-DoD satellite systems. The CONOPS also characterizes goals for minimal SCS reconfiguration time; the capability to support operations with appropriate backup; the employment of flexible command, control, communications, and data processing; and the logistics support processes identified in Integrated Weapon Systems Management policies. NOTE: Although all future space systems may not be satellites, the term "satellite" is used in this CONOPS for all space systems requiring SCS support.

3.0 Operating Environment. The SCS will be composed of hardware, software, communications, and facility resources located on the ground and in space. The GS will encompass both common-user resources (available to multiple space programs and users) and mission specific resources (uniquely required by individual space programs). Sharing of resources will be encouraged to maximize utilization rates, lower costs, and provide flexibility in responding to user requirements. A worldwide communications element linking the GS to the various operators and users of the SCS will be composed of government owned/leased land lines, meteorological conditions including severe thunderstorms, lightning, tornadoes, hurricanes (typhoons), fog. temperature variations and changing wind conditions. Calculations for SS accessibility will account for terrain constraints such as line-of-sight, obscura, and multipath refraction. Space operations will be prepared for the effects of space environmental conditions including solar flares, solar wind, radiation, electromagnetic interference, eclipses, space debris, etc.

3.3.4 The SCS is expected to operate in support of U.S. forces, policies, strategies, and interests worldwide during peacetime, war, and all intermediate levels of conflict. In addition, the SCS operational survivability will be commensurate with forces supported as specified in applicable AFSPACECOM requirements documents and war plans. This survivability will be dependent upon specific space vehicle (SV) missions; the extent of autonomy, hardening, or proliferation of supported SVs; and the use of mobile/transportable TT&C and mission GS terminals.

3.3.5 Hostile foreign threat information is contained in the classified Air Force Intelligence Command, Foreign Aerospace Science and Technology Center Threat *Environment Description* (TED) *for Space System.* Threats from terrorists, criminals, or espionage are contained in the classified Air Force Office of Special Investigation *Multi-Disciplinary Intelligence (MDI) Threat Assessments. This* CONOPS will be revised as necessary when updates to the TED or MDIs are received.

4.0 Mission. The 50 SPW will operate and manage the SCS to effectively and efficiently control. space systems and to distribute space system information in support of U&S CINC warfighting requirements as well as the Mission Areas (MAs) of other designated space systems and users. The MAs for satellite control as established by the Office of the Under Secretary of Defense for Acquisition, are Space Launch and Orbital Support (MA 410) and Defense-Wide Mission Support Programs (MA 400).

4.1 Mission (Expanded). Satellite Control operations are a Force Support mission integral to the success of the Force Enhancement, Force Application, and Aerospace Control missions. Operational crews, who will employ ground and space segment resources of the SCS, perform satellite control. Section 5.0 describes the SCS segments and elements as well as their operational roles. The SCS enables command and control operations and mission support operations throughout the space systems' programmed life (Pre-Launch, Launch, Checkout, On-orbit Operations, and End-of-Life Disposition). The SCS will be used to exercise Satellite Control Authority (SCA) which is defined as the authority to direct, approve, perform, and/or delegate the execution of satellite command and control procedures on a specific satellite (e.g., to maintain the satellite in a safe operating configuration, to take necessary actions to safe the satellite, and to implement approved satellite hardware and flight software configurations). The 50 SPW will perform AFSPACECOM SCA activities and other support to satellite systems as required or tasked by a wide variety of customers. These customers include US Air Force, Army, Navy, Marine, RDT&E, National, Allied, Civil, and Commercial agencies.

4.2 Mission Scenario. For each new SV, the mission scenario performed by satellite control operations begins with planning for support to the launch, checkout, and on-orbit activities for the vehicle. Detailed support requirements and system characteristics are analyzed to define the specific satellite command and control and payload processing capabilities required. Hardware and software are developed and procured IAW the standards established for the SCS. Procedures in the cost of developing, acquiring, and supporting space operations. Specifically, the goal is to achieve cost reductions of up to 2.5 percent by the year 2000.

5.0 Operational System. Satellite control Will be performed through the employment of an integrated, interoperable system consisting of both SS and GS elements (Figure 1). The SCS will be a robust and responsive mix of facilities, equipment, software, communications, and support resources that are integrated to perform launch support and satellite control operations for DoD and non-DoD space systems. The SCS will be operated through an appropriate mix of fixed and mobile/transportable ground facilities equipped with sufficient capabilities to provide satellite control operations for all supported satellite systems across the spectrum of possible conflicts. The SCS capabilities will be developed/upgraded in an evolutionary manner with the objective of eliminating unique or dedicated SCS elements, hardware, software, procedures, and interfaces. Satellite control operations will be standardized to allow a responsive reconfiguration of network resources (when required), to reduce the life-cycle cost of GS activities, and to provide a robust set of support services. The SS and GS will be flexible to rapidly incorporate new concepts of operations and architectures driven by changes in mission need and/or threat, or advances in technology that could increase mission performance and/or reduce operating costs. At the same time, new satellite programs requiring SCS support will be compatible with standard SCS interfaces and procedures. External users and their systems will also utilize the SCS standard interfaces for communications and systems compatibility. The' SCS will offer a set of standards with flexibility to meet the needs of both the DoD and non-DoD space communities. Finally, the SCS will implement a communications architecture that will support AFSPACECOM and other user's satellite control operations and mission data collection/processing/dissemination with flexible connectivity throughout all levels of conflict, in an effective and cost-efficient manner (from either SCS primary or backup resources).

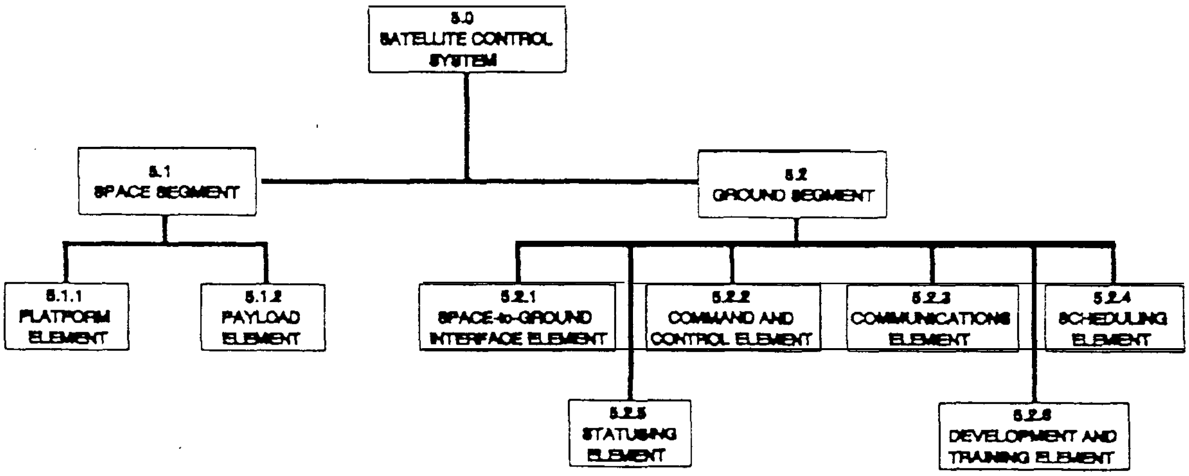

Figure 1

5.1 Space Segment. The SS consists of platform and payload elements aboard SVs or SV constellations. The platform is that part of a SV which serves as a host for rhe specific payload(s) and provides essential support systems (power, fuel, communications, etc.) that allow a SV to operate throughout its lifetime. A payload is that part of a SV which performs a specific mission and provides specific mission data or capabilities to the customer(s). New DoD SVs to be operated by the SCS will be designed and procured to be compatible with continuing or planned employ automation and standardized systems, procedures, and interfaces to increase SCS efficiency and performance in a cost-effective manner.

5.2.1 Space-to-Ground Interface Element. This element receives space system downlinks (telemetry and position data), transmits uplinks (commands), and generates tracking information. Interfaces with command and control, and communications elements allow appropriate collection and routing of space system platform and/or payload data to satisfy operational objectives. As much as is operationally judicious, antennas used throughout the GS will be standard in capability, power, wave form, hardening requirements, anti-jam capability, and operational procedures by type (SGLS, EHF, etc.) and size (10M, 46ft, etc.). To the greatest extent practical, the space-to-ground interface element will be remotely operated and only require a minimal site maintenance crew.

5.2.2 Command & Control Element (CCE). This element is implemented in the Satellite Operation Center (SOC) or equivalent facility which processes space system downlink data and generates uplink commands to satisfy operational requirements. Functions performed may include data archival, processing, display, analysis, and distribution; commanding of satellites, either real-time (execute on receipt) or stored (execute later); over-the-air rekey; orbit, position, and orientation determination; equipment configuration; payload management planning; and status reporting. This element forms the hub of satellite control operatioris by interfacing to the other internal and external elements, as well as external networks. Automation, a distributed architecture, and improved Human Computer Interfaces (HCI) coupled with standardized satellite control procedures and support documentation at the SOCs will improve cost and operational effectiveness, decrease training and operations control timelines, allow for operator intervention on a “by exception” basis, and provide greater flexibility in operations. Multiple satellite control functions will be conducted simultaneously; such as telemetry analyses, orbit analyses, commanding, mission data processing activities, mission planning, rehearsals, exercises, and training; without degradation to the overall CCE or satellite operations performance. A distributed architecture will also support rapid modification of hardware/software (concurrent development with operations and/or timely integration of mission specific hardware/software) as well as efficient expansion for increased loading or backup scenarios (portability of software across hardware platforms as well as allocation and assignment of additional resources). The SCS will employ HCIs that allow combined operator functions and data displays as a series of graphical user interface windows. The SCS will be designed to provide satellite control operations for DoD programs currently using dedicated networks and system elements. Whenever feasible, unique or redundant ground resources will be phased out, thus standardizing and improving interoperability across assigned missions.

5.2.3 Communications Element (Comm). This element encompasses the use of government owned/leased communications resources to connect SCS elements and route data, voice, and video information as required by SCS operators and users. It will maximize use of the Digital Integrated System Network (DISN) where technically plausible, in order to take advantage of its inherent redundancy at a reduced cost. The Comm element configures equipment; provides communications services; monitors end-to-end communications performance; and records, processes, and distributes information as needed to meet mission requirements. External connectivity will support the transfer of entire databases, including multi-media databases and files (e.g., text, video, graphics, imagery, audio, data, and simulations) between SCS operational SOCs or equivalent facilities, external users. and backup resources. The SCS will support both

6.1 Approach. SCS employment will provide an architecture that maximizes use of standard interfaces, procedures, and data displays for use by operators. This architecture is based upon standardized common-user components/elements eliminating the need for any uniyue, stand-alone ground- or space-based instrumentation or communication capabilities for common satellite control functions. Decisions as to the evolution of this architecture will be based on proven new technologies, individual and/or aggregate program requirements for mission data, optimization of automation to reduce manpower utilization, and funding levels.

6.1.1 The SCS architecture is intended to influence the design of future satellites with regard to autonomy, crosslinking/crossbanding, standard TT&C interfaces, and processing to include standard platform architectures and payload interfaces. Flexibility will be designed into SCS to allow for easy access by future space-based systems. Once this SCS architecture is in place Falcon AFB will primarily conduct AFSPACECOM satellite control operations without [he need for numerous TT&C sites dispersed throughout the world. At each operational facility, crew operations will be centralized for efficiency and cost effectiveness. A dedicated duplicate SCS capability is not required for backup operations, however the SCS will be capable of performing selected satellite control operations from one or more possible geographically dispersed backup locations. Survivability of satellite control operations may be satisfied through mobile/transportable ground elements which could also be used for backup operations. Such mobile/transportable ground elements will be standardized and interoperable with each other and with their fixed counterparts.

6.1.2 All elements of the GS will be designed and operated for common-use and will be deployed at a minimum number of locations. Decisions on how to design and modify the ground architecture will be made based upon new and continuing mission requirements, required O&M capabilities, approved standards, and advances in technology which will optimize O&M costs SCS interfaces and capabilities will influence the design of new space systems and programs. Flexibility will be designed into the SS and GS in order to adapt to new requirements (such as alternative frequencies) and technology (e.g., expert systems) as well as to provide continued support to existing on-orbit SVs. SCS employment will consider standardization where increased mission effectiveness and/or reduced costs will be realized. Flexible elements and standard interfaces will facilitate use of the SCS as a National common-use system.

6.2 Characteristics. SCS functionality will be an evolutionary successor to today's satellite control capabilities through a phased approach towards the acquisition and infusion [illegible] technology. The system will provide a broader range of capabilities, in order to support both previously established satellite program needs (SVs in production prior to 1995, yet still performing their missions), and the validated needs of newer space missions. The system will be flexible enough to meet changes in tasks based on mission requirements or the politic; environment. The system will optimize use of standard operating procedures and interfaces for a majority of users, yet the system will also be able to meet unique space missions (e.g. research and development missions, one-time tests, etc.). In order to support the SCS employment approach, satellite control elements will meet the following characteristics:

6.2.1 Availability. Satellite control capability will be available at all times to all satellites assigned. This means that through the use of multi-paths, interoperability, and crosslinking/crossbanding, as well as rescheduling of SCS resources, TT&C data from any assigned satellite can be continuously available at a SOC (or equivalent facility). Future DoD SVs exchanged data. Standardized SCS access will be available (by priority) to all users, while maintaining security requirements.

6.3 Mission Operations. Operation of the SCS will be conducted in three phases: generation, execution, and recovery. The SCS will have the flexibility to operate in all phases simultaneously, as well as the capacity to operate multiple mission scenarios for assigned satellite programs concurrently. Depending upon the specific mission scenario, an individual SOC (or equivalent facility) may simultaneously support more than one SV, satellite program, and/or phase.

6.3.1 Generation Phase. This phase encompasses those activities required in preparation for the execution phase. This includes operational training, rehearsals, scheduling, planning, and operational testing of assets.

6.3.1.1 Training. AFSPACECOM will chair a Training Planning Team (TPT) to develop a System Training Plan (STP) IAW AFP 50-l 1. The STP will define the training concept and ensure the training system is maintained throughout the life cycle of the operational system. The training system must be upgraded and maintained concurrently with the operational system. Specific training system configuration will be based on results of a Training System Requirements Analysis (TSRA).

6.3.1.1.1 Type 1 Training. The prime contractor(s) will provide training to an initial cadre of Air Force personnel. The training will be developed using the Instructional System Development (ISD) process and be in a format that meets AFSPACECOM requirements according to MIL STD 1379D. Contractors will also provide detailed operational/maintenance procedures and equipment descriptions in the form of Technical Orders (T.O.s). These T.O.s will be updated as the system changes throughout the program life cycle.

6.3.1.1.2 Air Force Training. AFSPACECOM satellite command and control operators will attend Undergraduate Space and Missile Training (USMT) (for officers) or Space Systems Operations Specialist Training (for enlisted) where they will receive basic training for the space operations career field. Operators will then attend AETC Initial Qualification Training (IQT) to prepare them for assignment At the unit, operators will receive Unit Qualification Training (UQT) and be evaluated prior to certification as “mission ready.” All mission ready personnel will receive recurring training per AFSPACECOM policy.

6.3.1.2 Pre-Launch and Early Orbit **(LEO)/Rehearsals.** Prior to Launch and Early Orbit (LEO) operations and Contingency LEO operations, the SOC (or equivalent facility) crews conduct end-to-end SCS compatibility testing (SOC or equivalent facility to the satellite at the factory) to validate the SW/database. Additionally, the SOC (or equivalent facility) crews conduct interactive standalone or end-to-end (SOC or equivalent facility to haunch vehicle/satellite) rehearsals to simulate all pre-launch, launch, and early-orbit checkout. crew procedures. As appropriate, rehearsals involve participation and planning with the launch and user organizations to ensure proper information flow and communications configurations for these operations.

6.3.1.3 Scheduling. An integrated automated scheduling element will be employed resident in and/or accessible from each SOC (or equivalent facility). A centralized scheduling office will accept inputs and control scheduling changes. Scheduling conflicts will be minimized as a result be through a message downlinked. or relayed to a universal receive antenna at Falcon AFB. In either case, crew members will be alerted by an on-screen prompt identifying which SV is transmitting a fault indication, its location, and the fault in question. A designated crew member will then be able to access data screen(s) which provide the entire status of the focus SV, to include orientation, status of on-board systems, payloads, the communication links, etc. The crew member will then process the fault indications via fault procedure checklists. After correcting the fault, the crew member will terminate communications with that SV, perform reporting as necessary, and wait for the next SV contact activity. In situations where a fault procedure checklist has not been developed or is unable to correct the fault, the crew member will notify the satellite engineer. The engineer will then direct the appropriate corrective action, For all SVs requiring extra attention, due to one or more recurring subsystem discrepancies, CMRO activities may increase in order to ensure mission objectives continue to be met.

6.3.2.4 Satellite Disposition Operations. These operations occur when a SV is not controlled through day-to-day routine operations. A typical scenario involves a partially deactivated SV (e.g., operational spares, payload partially inoperative, etc.) requiring support less often by the regular SOC (or equivalent facility). Another scenario involves totally deactivated SVs (e.g., payload inoperative, platform operative) supported by Test and Checkout (TACO) operations with non-standard procedures or via an alternate SOC (or equivalent facility). A final scenario involves a SV near its end-of-life due to anomaly resolution supports becoming ineffective, the SV is unable to maintain proper state-of-health for routine satellite control operations, or consumables/redundant components reach minimal levels. In this end-of-life case, the organization with SCA and the user will determine the SV's disposition process. This will either be to completely shut the SV off in place, or boost/deboost the SV to an unusable orbit (e.g., super synchronous orbit, re-entry into the atmosphere, etc.). For boost or deboost scenarios, the SOC (or equivalent facility) will provide non-standard operations/tracking until the SV is clear of the operational space orbits. Satellite disposition operations are usually time consuming and manpower-intensive.

6.3.3 Recovery Phase. This phase encompasses the reconfiguration of the SV and GS back to nominal configurations, if changed. It also includes all post-execution phase tasks such as data reduction, data analysis, data playback, and data dissemination. In the future, all types of mission data will be provided in a standard format via a standard interface to the particular users. To the greatest extent possible, this aspect of the operations will be fully automated requiring minimal human interface.

6.4 General Support. O&M support functions are to be performed using integrated systems and standardized procedures and support documentation to the greatest extent feasible. This approach should result in more effective and cost-efficient mission accomplishment, with less risk and disruption to the mission.

6.4.1 Operations. The SCS maintenance concept will provide planned methods to be employed in order to sustain the SCS at a level of readiness adequate to support operational requirements. The maintenance concept will guide the formulation of maintenance design characteristics needed to achieve the optimum balance between operational effectiveness and logistical support costs. Maintenance concepts will be updated to consider practical, low-risk trade-offs between operational requirements and engineering designs.

understand SCS capacities in order to accurately plan and implement SV supports and to project requirements for workarounds/new capabilities.

6.4.5 Documentation. Standardized operations and support documentation (Ops plans, control plans, procedures, etc.) will be developed. These documents will be developed to meet satellite control, user, and support requirements by utilizing initially the current Universal Documentation System and then transitioning later to a more efficient and integrated on-line computer capability. The SCS will utilize the Core Automated Maintenance System (CAMS) to meet the requirements for a Maintenance Data Collection (MDC) system that can define supply support requirements and all other supportability concerns for maintenance. CAMS will be used as a database for the Reliability and Maintainability Information System (REMIS) which will tie into the Weapons Systems Management Information System to forecast force projection for operational concepts and operations as well as identify supportability concerns for the maintenance concept.

6.4.6 Personnel. DoD personnel (bluesuit/civilian) will provide contractor oversight in the areas of contract compliance, quality assurance, mission planning and mission execution. Configuration control of the SCS will be the responsibility of AFSPACECOM personnel. Bluesuit/contractor teams (depending on location, mission, and cost) will perform SCS O&M. AFSPACECOM personnel will review and approve operations checklists and procedures for COCOM elements. Elements of the SCS will be configured for use by operators and technicians rather than by engineering teams. Automation will be utilized wherever practical to limit the manpower and skill levels required to operate, maintain, and configure operational systems. Operator functions for routine operations/maintenance will be integrated and combined where practical.

7.0 Security. National and DoD space policy requires the highest degree of security for operational resources critically important to national security. Early attention to security for SCS resources, in their acquisition and modification stages, is essential. User, Air Force, and DoD requirements derive top level security requirements. Safeguarding all SCS operations is necessary to maintain the overall effectiveness of U.S. pre-launch, launch, and post-launch operations. Capability to support classified and unclassified operations simultaneously without compromise will be maintained. Multi-level secure systems will be utilized to minimize duplication of systems solely due to security constraints. Satellite control operations and the SCS must comply with applicable security regulations, policy directives, instructions, publications, and security classification guides to include physical security, emanation security, communications security, operations security, computer security, and industrial security. In addition, SCS systems and procedures must prevent disclosure of mission plans, status, and payload information commensurate with the security requirements of the space programs and users supported.

8.0 Safety. Safe and controlled operations are mandatory for successful mission accomplishment. DoD 3200.11 designates the Wing Commander as the final authority for safety in the SCS. The 50 SPW's safety regulations will delineate flight safety policy and procedures. The objective of Wing Safety is to ensure all phases of operations are performed within acceptable safety limits consistent with mission requirements and national needs.

9.0 Logistics Support. Logistics support of the SCS will utilize the Integrated Weapon System Management logistics structure. This logistics concept will provide integrated support to the SCS through the entire life cycle of its elements.